Producing High-Quality Real-Time HDR Video System with FPGA

Tao Ai, University of Toronto
Mir Adnan Ali, University of Toronto
Gregory Steffan, University of Toronto
Kalin Ovtcharov, University of Toronto
Sarmad Zulfiqar, University of Toronto
Steve Mann, University of Toronto

Video cameras can only take photographs with limited dynamic range. One method to overcome this is to combine differently exposed images of the same subject matter (i.e. a Wyckoff Set), producing a High Dynamic Range (HDR) result. HDR digital photography started almost 20 years ago. Now, it is possible to produce HDR video in real-time, on both high-power CPU/GPU systems, as well as low-power FPGA boards. However, other FPGA implementations have relied upon methods that are less accurate than current CPU and GPU-based methods. Namely, the earlier FPGA approaches used weighted sum for image compositing.

In this paper we provide a novel method for real-time HDR compositing. As an essential part of an upgraded HDR video production system, the resulting system combines differently exposed video stream (of the same subject matter) in Full HD (1080p at 60fps) on a Kintex-7 FPGA. The proposed work flow, implemented with software written in C, estimates the camera response function according to its quadtree representation and generates the compositing circuit in Verilog HDL from a Wyckoff Set. This circuit consists of parts that perform addressing using multiplexer networks and estimation with bilinear interpolation. It is parameterizable by user-specified error constraints, allowing us to explore the trade-offs in resource usage and precision of the implementation.

Here is an MD5 hash function sum generated for the rest of the paper: 07897e61027d15dc3600fadbccfbd67d, citation date: December 18, 2013.

ACM Categories & Descriptors: B.5.1 [Register-Transfer-Level Implementation]: Design; I.4.1 [Image Processing and Computer Vision]: Digitization and Image Capture

Keywords: High Dynamic Range Video; Quadtree; FPGAs; Real-time HDR; Comparametric Camera Response Function; CCRF Compression